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10 CFR 50.4

LR-N16-0136

DEC 30 2016

U.S. Nuclear Regulatory Commission
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Washington, DC 20555

Salem Generating Station Units 1 and 2
Renewed Facility Operating License Nos. DPR-70 and DPR-75
NRC Docket Nos. 50-272 and 50-311

Subject: NEI 12-06, Appendix H, Revision 2, H.4.3 Path 3: GMRS > SSE but < IHS, Mitigating Strategies Assessment (MSA) report for the New Seismic Hazard Information

References:

1. NEI 12-06, Revision 2, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," December 2015 (ADAMS Accession No. ML16005A625)
2. NRC Interim Staff Guidance JLD-ISG-2012-01, Revision 1, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," January 2016 (ADAMS Accession No. ML15357A163)
3. PSEG Letter LR-N14-0051, "PSEG Nuclear LLC's Seismic Hazard and Screening Report (CEUS Sites) Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident - Salem Generating Station," dated March 28, 2014 (ADAMS Accession No. ML14090A043)
4. NRC Letter, "Salem Nuclear Generating Station, Units 1 and 2 - Staff Assessment of Information Provided Pursuant to Title 10 of the Code of Federal Regulations Part 50, Section 50.54(f), Seismic Hazard Reevaluations for Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident (CAC Nos. MF3922 and MF3923)," dated February 18, 2016 (ADAMS Accession No. ML16041A033)

5. PSEG Letter LR-N15-0255, "High Frequency Supplement to Seismic Hazard Screening Report, Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," dated December 23, 2015 (ADAMS Accession No. ML15358A139)
6. EPRI Report 3002004396 "High Frequency Program Application Guidance for Functional Confirmation and Fragility Evaluation," July 2015 (ADAMS Accession No. ML15223A102)
7. NRC NUREG-1407, "Procedural and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities," June, 1991 (ADAMS Accession No. ML063550238)
8. EPRI Report 1025287, "Seismic Evaluation Guidance, Screening, Prioritization and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic," February 2013
9. Updated Final Safety Analysis Report, Salem Generating Station Units 1 and 2, Revision 28
10. NRC Letter, "Staff Review of High Frequency Confirmation Associated with Reevaluated Seismic Hazard in Response to March 12, 2012 50.54(f) Request for Information," dated February 18, 2016 (ADAMS Accession No. ML15364A544)
11. PSEG Letter LR-N16-0120, "Salem Generating Station Unit 1 Compliance with March 12, 2012 NRC Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis Events (Order Number EA-12-049) and Final Integration Plan for Units 1 and 2," dated September 28, 2016 (ADAMS Accession No. ML16273A349)
12. PSEG Letter LR-N16-0094, "Spent Fuel Pool Evaluation Supplemental Report, Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," dated December 6, 2016 (ADAMS Accession No. ML16342C496)

The purpose of this letter is to provide the results of an assessment for Salem Generating Station (SGS) Units 1 and 2 to demonstrate that an Individual Plant Examination of External Events (IPEEE) based alternate mitigating strategy (AMS) can be implemented considering the impacts of the reevaluated seismic hazard. The assessment was performed in accordance with the guidance provided in Appendix H of NEI 12-06 Revision 2 (Reference 1), which was endorsed by the NRC (Reference 2).

The Mitigating Strategies Seismic Hazard Information (MSSHI) is the licensee's reevaluated seismic hazard information at SGS, developed using Probabilistic Seismic Hazard Analysis (PSHA). The MSSHI includes a performance-based Ground Motion Response Spectrum (GMRS), Uniform Hazard Response Spectra (UHRS) at various annual probabilities of exceedance, and a family of seismic hazard curves at various frequencies and fractiles developed at the SGS control point elevation. PSEG Nuclear LLC (PSEG) submitted the reevaluated SGS seismic hazard information including the UHRS, GMRS and the hazard curves to the NRC on March 28, 2014 (Reference 3). The NRC staff concluded the GMRS adequately characterizes the reevaluated seismic hazard for the site (Reference 4).

Section 6.1.2 of Reference 2 identifies that the method described in Section H.4.3 of Reference 1 is applicable to SGS. Consistent with Section H.4.3 of Reference 1, the SGS GMRS is bounded by the high-confidence-of-low-probability-of-failure (HCLPF) spectrum developed from evaluations for the IPEEE in the frequencies of interest below 10 Hz – referred to as the IHS. Based upon the mitigating strategies assessment provided in Attachment 1, the mitigating strategies for SGS considering the impacts of the reevaluated seismic hazard can be implemented as designed.

Furthermore, system, structures, and components (SSCs) that are shown to be robust with respect to the hazards are considered to be fully available to mitigate the consequences of the MSSHI. The SGS Units 1 and 2 safe shutdown earthquake (SSE) design basis response spectrum is specified in Updated Final Safety Analysis Report (UFSAR, Reference 9), Section 3.7.1. All SGS Seismic Category I SSCs are required to be evaluated to the SSE design basis response spectrum. As described in Reference 3, the SSE design basis response spectrum bounds the GMRS in frequencies between 1 Hz and 10 Hz; and the GMRS exceeds the SSE design basis response spectrum for a discrete range greater than 10 Hz. Per Reference 10, the NRC Staff has confirmed that the SGS Units 1 and 2 exceedance over the limited frequency range meets the "Limited High Frequency Exceedance Screening" acceptance criteria criterion provided in EPRI Report 3002004396 (Reference 6) and does not warrant further evaluation. As a result, the SGS Seismic Category I SSCs are designed with sufficient ruggedness and would be fully available to mitigate the consequences of a seismic event characterized by the MSSHI. Other portable equipment credited for diverse and flexible (FLEX) strategies is not required to be available. Other portable FLEX equipment provides additional mitigating capabilities and serves as defense-in-depth to the existing safety systems.

There are no regulatory commitments contained in this letter. If you have any questions or require additional information, please do not hesitate to contact Mr. Lee Marabella at 856-339-1208.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on 12/30/16
(Date)

Sincerely,

Charles V. McFeaters
Site Vice President
Salem Generating Station

Attachment 1: Seismic Mitigating Strategies Assessment for Salem Generating Station Units 1 and 2

cc: Mr. Daniel Dorman, Administrator, Region I, NRC
Ms. Carleen J. Parker, Project Manager, NRC/NRR/DORL
Mr. Nicholas DiFrancesco, Project Manager, NRC/NRR/JLD
Mr. Patrick Finney, NRC Senior Resident Inspector, Salem
Mr. Patrick Mulligan, Chief, NJBNE
Mr. Thomas Cachaza, Salem Commitment Tracking Coordinator
Mr. Lee Marabella, PSEG Corporate Commitment Coordinator

Attachment 1

Seismic Mitigating Strategies Assessment for Salem Generating Station Units 1 and 2

Seismic Mitigating Strategies Assessment for Salem Generating Station Units 1 and 2

References in this attachment are provided in the transmittal letter.

1 INTRODUCTION

The purpose of this mitigating strategies assessment (MSA) is to evaluate and demonstrate that Salem Generating Station (SGS) Units 1 and 2 can mitigate the effects of the reevaluated seismic hazard information developed pursuant to the NRC's 10 CFR 50.54(f) letter dated March 12, 2012. The assessment was performed in accordance with the guidance provided in Reference 1, which was endorsed by the NRC (Reference 2).

The Mitigating Strategies Seismic Hazard Information (MSSHI) is the reevaluated seismic hazard information at SGS developed using the Probabilistic Seismic Hazard Analysis (PSHA). The MSSHI includes a performance-based Ground Motion Response Spectrum (GMRS), Uniform Hazard Response Spectra (UHRS) at various annual probabilities of exceedance, and a family of seismic hazard curves at various frequencies and fractiles developed at the SGS control point elevation. SGS submitted the reevaluated seismic hazard information including the UHRS, GMRS and the hazard curves to the NRC on March 28, 2014 (Reference 3). The NRC staff concluded that the GMRS submitted by PSEG adequately characterizes the reevaluated seismic hazard for the SGS site (Reference 4).

Reference 1 discusses a method to develop an alternate mitigating strategy (AMS) to address the MSSHI. This includes a modification of the general criteria and baseline assumptions included in Section 3.2.1 of Reference 1 to exclude consideration of losses such as an extended loss of AC power (ELAP), loss of offsite power (LOOP), or loss of ultimate heat sink (LUHS) unless caused by the seismic hazard. Reference 2 provides an NRC staff position that the "Path 3" method described in Section H.4.3 of Reference 1 for an AMS is acceptable for mitigating a beyond design basis external event. Path 3 uses the seismic evaluations performed for the Individual Plant Evaluation of External Events (IPEEE) as an AMS to address the MSSHI. The protection of onsite power sources and normal access to the UHS from the seismic hazard is an acceptable method of mitigating a simultaneous loss of all AC power and loss of normal access to the ultimate heat sink.

2 MSSHI PATH 3 DOCUMENTATION

The following sections provide the documentation required by Reference 1 in order to use a previously performed IPEEE as an AMS to address MSSHI.

2.1 Comparison of GMRS to IHS

PSEG submitted the reevaluated SGS seismic hazard information including the UHRS, GMRS and the hazard curves to the NRC on March 28, 2014 (Reference 3). The NRC staff concluded that the GMRS adequately characterizes the reevaluated seismic hazard for the site (Reference 4).

Screening using the seismic IPEEE Hazard Spectrum (IHS) is described in Reference 3. Consistent with Section H.4.3 of Reference 1, the SGS GMRS is completely enveloped by the IHS with the exception of a small exceedance below 1.5 Hz that satisfies EPRI 1025287 (Reference 8) criteria. The NRC staff accepted the screening in Reference 4.

2.2 IPEEE Description and Adequacy from March 2014 Submittal

An IPEEE based AMS relies on the seismic evaluation of plant equipment to demonstrate ruggedness of structures, systems and components (SSCs) to the MSSHI. The SGS IPEEE relied on the results of a Seismic Probabilistic Risk Assessment (SPRA) to demonstrate the capability to bring the plant to a safe shutdown condition following a review level earthquake (RLE) as described in NUREG-1407 (Reference 7). The SGS IPEEE was considered a focused scope plant evaluation.

The IPEEE adequacy was submitted to the NRC staff as Appendix B to Enclosure 1 of Reference 3. The NRC staff accepted the IPEEE adequacy in Reference 4. As stated in Section 3.3.1 of EPRI 1025287 (Reference 8), focused-scope IPEEE submittals may be used for screening against the GMRS provided they are enhanced to bring them in line with full scope assessments. The enhancements include (1) a full scope detailed review of relay chatter and (2) a full evaluation of soil failures.

2.2.1 IPEEE Full Scope Relay Chatter Review

The SGS IPEEE was a focused scope evaluation and it included a low ruggedness relay evaluation. SSCs that are robust with respect to the hazards are considered to be fully available to mitigate the consequences of the MSSHI. The low ruggedness relay review concluded that relay chatter is not significant to safe shutdown or containment performance after a seismic event at SGS.

The SGS SSE design basis response spectrum is specified in UFSAR (Reference 9), Section 3.7.1. All SGS Seismic Category I SSCs are required to be evaluated to the SSE design basis response spectrum, including the relays in safety-related circuits. As described in References 3 and 5, the SSE design basis response spectrum bounds the GMRS in frequencies between 1 Hz and 10 Hz; and the GMRS exceeds the SSE

design basis response spectrum for a discrete range greater than 10 Hz. Per Reference 10, the NRC Staff has confirmed that the SGS Units 1 and 2 exceedance over the limited frequency range meets the "Limited High Frequency Exceedance Screening" criterion provided in EPRI Report 3002004396 (Reference 6) and does not warrant further evaluation. As a result, the SGS Seismic Category I SSCs are designed with sufficient ruggedness and would be fully available to mitigate the consequences of a seismic event characterized by the MSSHI.

PSEG considers that the conservative and bounding nature of the SGS design-basis response spectrum relative to the MSSHI, with limited high frequency exceedances, augments the IPEEE conclusion that relay chatter is not significant at SGS and satisfies the full-scope relay chatter review.

2.2.2 Soil Failure Analysis

SGS completed a soil failure analysis as part of the IPEEE even though it was not required to do so as a focused scope plant. The soil failure analysis considered soil liquefaction, foundation settlement and slope stability. Results of the soil failure analysis are therefore considered in the SPRA and IPEEE conclusions.

2.2.3 IPEEE Adequacy

As described above, the SGS IPEEE is consistent with the requirements for a full scope IPEEE plant for the GMRS. Accordingly, the IPEEE is adequate to demonstrate that the plant systems are designed with sufficient ruggedness to mitigate a seismic event consistent with the reevaluated seismic hazard. The Spent Fuel Pool (SFP) Evaluation for the MSSHI is provided in Section 2.3.

2.3 Spent Fuel Pool Evaluation

Evaluations for SFP cooling capabilities were not in the scope of the IPEEE. The IPEEE evaluation is therefore supplemented with an AMS for the MSSHI to address capabilities to maintain cooling and prevent damage to fuel in the spent fuel pool. Per Section H.4.3 of Reference 1, SFP cooling function should be evaluated using the criteria in H.5 to demonstrate seismic ruggedness of equipment to the MSSHI.

The SFP has been evaluated according to NRC-endorsed methodology and shown to be seismically adequate to retain adequate water inventory for 72 hours for the GMRS levels (Reference 12). The SGS FLEX methodology (Reference 11) developed according to NEI 12-06 considers offsite support to be available within 72 hours after a beyond design basis event. Accordingly, the SFP does not require make-up water capability for the MSSHI before off-site support capabilities are available.

Furthermore, the SGS SFP Cooling System for Unit 1 and Unit 2 is seismically rugged for the MSSHI levels. The SFP cooling system consists of a heat exchanger, two SFP cooling pumps, and associated piping and valves. The SFP cooling system components and piping are evaluated to the SGS SSE design-basis earthquake level as

described in UFSAR Section 9.1.3.3 (Reference 9). The SSE design basis response spectrum completely envelops the GMRS from 1 Hz to 10 Hz. Heat removal from the SFP Cooling System is through the SGS Component Cooling Water (CCW) system and Service Water (SW) system. The IPEEE included evaluation of the CCW and SW systems, which are designed to the SGS design basis SSE and are seismically rugged at the MSSHI level.

2.4 Indefinite Coping

The SGS IPEEE was based on the SPRA methodology. This approach defined the Seismic Equipment List (SEL) for evaluation of safe shutdown success paths that comprised SSCs required to bring the plant to a stable condition (either hot or cold shutdown) and maintain that condition. A review of the SGS IPEEE determined that conclusions of the SPRA are not sensitive to coping duration. Water and fuel oil inventories are evaluated to determine whether they require re-supply to obtain sufficient resources to sustain functions indefinitely.

The SGS FLEX methodology according to NEI 12-06 (Reference 1) considers site access to be near normal within 24 hours and offsite resources to be deployed within 72 hours after a beyond design basis event. A plant-specific evaluation identified there are no consumables that limit a 72-hour coping duration for the IPEEE. PSEG participates in the Strategic Alliance for FLEX Emergency Response (SAFER). PSEG Vendor Technical Document (VTD) 903060, "SAFER Response Plan for Salem Generating Station," includes provisions for delivery of fuel oil and water treatment equipment.

The SGS IPEEE includes the auxiliary feedwater storage tank (AFST) for makeup to the steam generators. The IPEEE SPRA credits the service water (SW) system as backup to the AFST. The SW system provides an indefinite supply source of cooling water from the Delaware River. It is a safety related system and is evaluated for availability in the SPRA. Availability of the SW system supports multiple options for decay heat removal for an indefinite period, i.e., via residual heat removal (RHR) and CCW systems, and as a source of auxiliary feedwater (AFW).

Additional backup AFW sources would be used as available but are assumed to be unavailable because they are not Seismic Category I. This assumption did not affect the IPEEE results. Operators would use the highest quality water available for injection to the SGs. SW can be aligned to directly supply AFW to the steam generators as the least preferred but reliable, safety-related, Seismic Category I water source.

The SPRA results are not sensitive to coping duration with respect to water sources. Based on the favorable comparison of the SGS design basis SSE to the MSSHI (i.e., design basis is bounding with limited exceedances), the complement of Seismic Category I SSCs would be available to support core cooling, reactor coolant system (RCS) inventory control and reactivity management, and containment cooling. Section 5.5.7.3.4 of the UFSAR (Reference 9) includes an evaluation of the ability of SGS to achieve and maintain cold shutdown assuming an SSE with loss of offsite power. The evaluation is appropriate to apply to the SGS MSSHI and demonstrates long term

coping capability by addressing four key functions, i.e., (1) circulation of the reactor coolant, (2) removal of residual heat, (3) boration and makeup, and (4) depressurization.

Long term containment cooling would also remain available using Seismic Category I SSCs without being limited by water inventory, i.e., via the SW system and containment fan coil units powered from emergency diesel generators.

Accordingly, water inventory does not limit the IPEEE conclusions for 72 hours.

Onsite fuel oil supplies supporting diesel generator operation are also sufficient for 72 hours. SGS Units 1 and 2 each contain two 30,000 gallon Fuel Oil Storage Tanks in addition to the diesel generator day tanks. The combined volume of both tanks at the Technical Specification minimum volume contains enough fuel to supply two station diesel generators for more than 72 hours when operating at the most limiting design-basis accident mitigation load profile (UFSAR Section 9.5.4, Reference 9). Accordingly, fuel oil inventory does not limit the IPEEE conclusions for 72 hours.

In summary, the conclusions of the SPRA are not sensitive to coping duration and consumable water and fuel oil supplies would not adversely affect IPEEE conclusions.

2.5 Availability of FLEX Equipment

The AMS does not rely upon the availability of FLEX equipment. However, FLEX equipment that is available provides defense-in-depth. On-site FLEX equipment is maintained available for deployment to support the maintenance of core cooling, containment, and spent fuel cooling functions.

Additionally, SGS maintains the capability to obtain additional portable FLEX equipment from offsite sources. No strategies need to be pre-planned for the use of the offsite equipment. The industry has established two (2) National SAFER Response Centers (NSRCs) to support utilities during beyond design basis events. SGS has established contracts with the Pooled Equipment Inventory Company (PEICo) to participate in the process for support of the NSRCs as required. Each NSRC will hold five (5) sets of equipment, four (4) of which will be able to be fully deployed when requested, the fifth set will have equipment in a maintenance cycle. In the event of a beyond-design-basis seismic event, equipment can be moved from an NSRC to an offsite staging area established by the SAFER team. From there, equipment can be taken to the site and staged at the SAFER onsite Staging Area by helicopter, if ground transportation is unavailable. Communications will be established between the site and the SAFER team via satellite phones and required equipment moved to the site as needed. Near normal site access and initial equipment deliveries from the NSRC are expected within 24 hours. Offsite resources to support core cooling, containment, and spent fuel cooling functions including fuel oil and water treatment equipment, are prioritized for receipt on site and deployment within 72 hours to support indefinite coping.

2.6 Additional Seismic Margin

The systems, structures, and components (SSCs) credited in the IPEEE are only a subset of all SGS SSCs. The Path 3 methodology only credits IPEEE SSCs as an AMS to mitigate the consequences of the MSSHI. Per Reference 1, Appendix H.5, other SSCs can be credited to mitigate the MSSHI if it can be demonstrated that they have adequate capacity to withstand the GMRS level of seismic hazard at the site.

The SSE ground response spectrum provided in the March 28, 2014 submittal (Reference 3) is the SSE ground response spectrum determined from site seismology as specified in Figure 2.5-12 of the SGS UFSAR (Reference 9). The SGS Units 1 and 2 SSE design basis response spectrum is specified in UFSAR Section 3.7.1. All SGS Seismic Category I SSCs are required to be evaluated to the SSE design basis response spectrum.

The SSE design basis response spectrum completely envelops the GMRS from 1 Hz to 10 Hz. The GMRS exceeds the SSE design basis response spectrum for a discrete range greater than 10 Hz. Per Reference 10, the NRC Staff has accepted the exceedance over the limited frequency range since it satisfies the acceptance criteria provided in EPRI Report 3002004396 (Reference 6) and does not warrant further evaluation. Therefore, all SCS Seismic Category I SSCs are designed with sufficient ruggedness to permit them to be credited for mitigation of the consequences of a seismic event characterized by the GMRS.

3 CONCLUSION

An IPEEE-based AMS relies on the seismic evaluation of plant equipment to demonstrate ruggedness of SSCs to the MSSHI. The IPEEE for SGS relied on the results of an SPRA to demonstrate the capability to bring the plant to a safe shutdown condition following a review level earthquake (RLE) as described in NUREG-1407 (Reference 7). Based on the results of the IPEEE, safe shutdown of the plant following a seismic event can be accomplished, and consequences can be mitigated, for a seismic event up to the plant capacity level (i.e., the IHS) for which the SSCs in the IPEEE were evaluated.

In addition to the SSCs credited in the IPEEE evaluation, all SGS Seismic Category I SSCs (including the SFP, the SFP cooling system, and safety-related relays) have been designed to seismic levels that are equivalent to or greater than the GMRS. Based on Reference 1, Appendix H.5, all SSCs Seismic Category I SSCs can be credited to mitigate the MSSHI since they have adequate capacity to withstand the SGS GMRS level seismic hazard. Therefore, portable equipment credited for other diverse and flexible coping (FLEX) strategies is not required to be available. The other portable FLEX equipment provides additional mitigating capabilities and serves as defense-in-depth to the existing safety systems.